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IS 4757 (1980): Wrapped Bushes [PGD 31: Bolts, Nuts and Fasteners Accessories]



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“Knowledge is such a treasure which cannot be stolen”

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Indian Standard
SPECIFICATION FOR
WRAPPED BUSHES

(First Revision)

1. Scope — Specifies main dimensions and tolerances of a range of wrapped bushes, with external diameters between 6 to 150 mm, for plain bearings. A reference is also made regarding constructional details and checking methods for main features.

2. Definitions — For the purpose of this standard, the definitions given in 'Indian Standard Terms, definitions and classification of plain bearings', (*under preparation*) shall apply.

3. Constructional Features — In certain cases, wrapped bushes with the split closed by a suitable interlocking (clinch) joint may be produced. Either single or multiple clinches may be provided for interlocking the butt joint. For bushes up to 50 mm length, generally a single clinch joint is provided. The standard shapes of clinches shall be as shown in Fig. 1.

4. Material — Typical composition of materials used for manufacture of wrapped bushes shall be as given in Appendix A and B.

5. Dimensions — The basic nominal dimensions housing internal diameter and bush wall thicknesses shall be as given in Table 1.

6. Tolerances

6.1 Housing Diameter — The tolerances H8, H7 or H6 [see IS : 919 (Part I)-1963 Recommendations for limits and fits for engineering: Part I General engineering (*revised*)] shall be chosen according to the available machining facilities and the final precision required. In the case of non-rigid housings or housings made of material with a high thermal expansion coefficient, grades 8, 7 or 6 shall be maintained but the deviation may be different from H.

6.2 Shaft Diameter — Shall be chosen according to the application and in particular according to the operational clearances permitted by the user.

6.3 Wall Thickness — These depend on the materials used and the manufacturing techniques. Slight surface depressions may be acceptable on the outside surface of bushes, provided that they are randomly distributed, however, thickness measurement shall not be carried out in these areas. Also the wall thickness around pierced holes, embossed/stamped grooves, stamped part numbers, pierced notches, slots may also deviate from the given tolerance to the extent of material flow during the respective operations and therefore, thickness tolerance shall not be applicable in these areas. However, the wall thickness shall not be plus in these areas for pre-finished bushes.

6.3.1 Bushes to be finished by the user — The wall thickness tolerance for bushes as formed by the manufacturer to be finished by user shall be:

- ± 0.035 on 0.75 thickness;
- ± 0.05 on 1, 1.5, 2 and 2.5 thicknesses; and
- ± 0.065 on 3, 3.5 to 4 thicknesses.

6.3.1.1 Finer tolerances may be agreed between user and the manufacturer, especially when the wrapped bushes are finished by the methods other than machining.

6.3.2 Bushes finished by manufacturer (pre-finished bushes) — Two methods are recommended for specifying the wall thickness/bore of pre-finished bushes.

Adopted 11 December 1980

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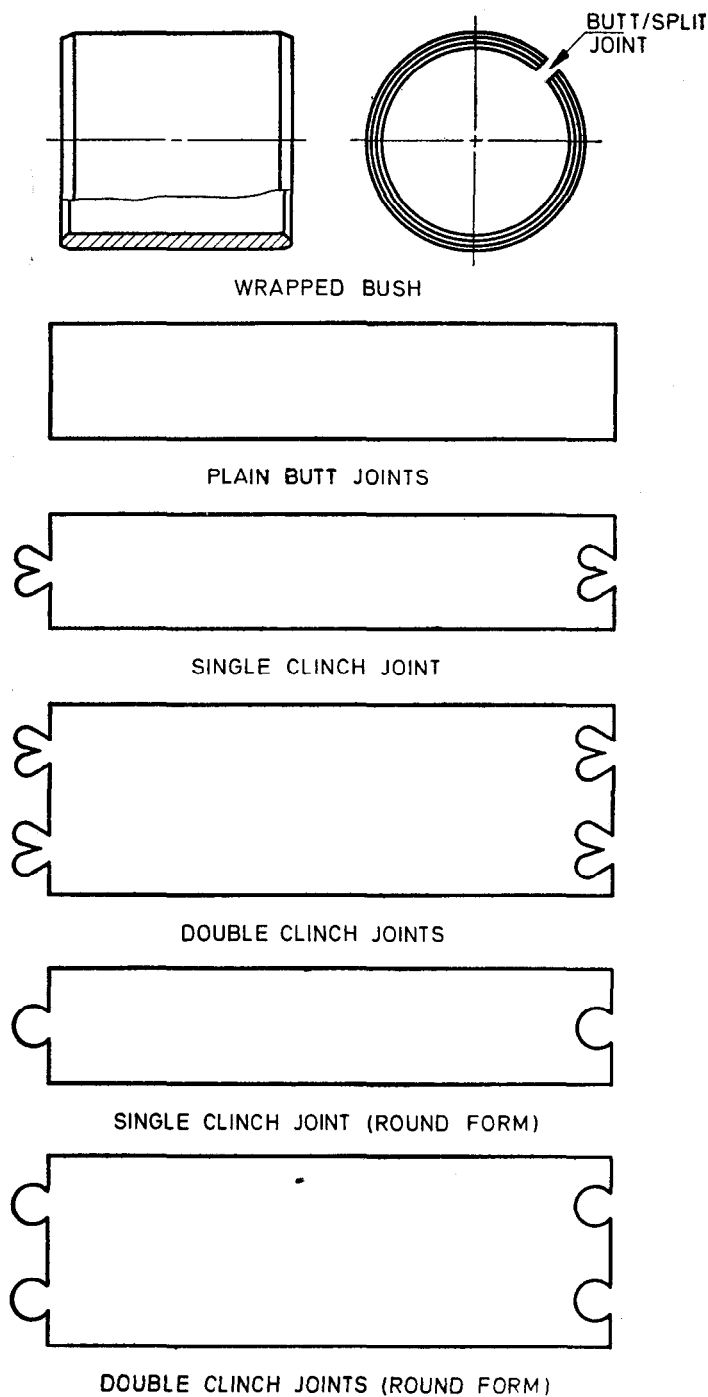


FIG. 1 DEVELOPED VIEWS OF WRAPPED BUSH AND FORMS OF CLINCH JOINTS

6.3.2.1 Measurement of wall thickness — For bush widths of 14 mm or less, measurements shall be taken at points on a circle situated at an equal distance from the two ends. For bush widths of over 14 mm measurements shall be taken at points on two circles situated 5 mm from each end.

Note — If the presence of grooves, holes or other details do not permit the measurement at the places specified above, other measuring points shall be chosen.

6.3.2.2 The tolerances on wall thickness shall be 0.025 for bushes up to 48 mm diameter and having width less than 50 mm and 0.050 for bushes over 48 mm diameter and/or 50 mm in length.

TABLE 1 HOUSING DIAMETERS, SHAFT DIAMETERS AND BUSH WALL THICKNESS

(Clause 5)

All dimensions in millimetres.

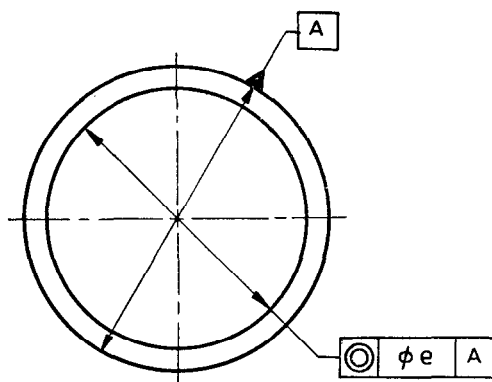
Preferred Housing Diameters	Non-preferred Housing Diameters	Shaft Diameters for Given Bush Wall Thickness							
		0.75	1	1.5	2	2.5	3	3.5	4
6	23	4.5	4						
7		5.5	5						
8		6.5	6						
9		7.5	7						
10		8.5	8						
11		9.5	9						
12		10.5	10						
13		11.5	11						
14		12.5	12						
15			13	12					
16			14	13					
17			15	14					
18			16	15					
19			17	16					
20			18	17					
21			19	18					
22			20	19					
24			21	20					
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			23	22					
26	27			23	22				
28				24	23				
30				25	24				
32				27	26				
34				29	28				
36				31	30				
38				33	32				
				35	34				
40				36	35				
42				37	36				
				39	38				
				41	40				
45				42	41	40			
48				45	44	43			
50				47	46	45			
53				50	49	48			
56	55				51	50	49		
					52	51	50		
60					53	52	51		
63					56	55	54		
					59	58	57		
67					61	60	59		
					63	62	61		
71					66	65	64		
75					67	66	65		
80					71	70	69		
					76	75	74		
85						80	79	78	
90						85	84	83	
95						90	89	88	
100						95	94	93	
105						100	99	98	
110						105	104	103	
	115					110	109	108	
120						115	114	113	
125						120	119	118	
130							124	123	122
140							134	133	132
150							144	143	142

6.3.2.3 Checking of internal diameter using plug gauges — Although only the thickness of a wrapped bush is directly measurable, one may be applying the method of checking as given in Appendix C, check the internal diameter obtained when the bush is fitted in a rigid housing of known diameter and calculate the coaxiality of the bore by measuring the thickness at diametrically opposite points of minimum and maximum wall thickness.

6.3.3 Method of indication of coaxiality — Shall be as given in Table 2.

TABLE 2 TOLERANCE ON INTERNAL DIAMETER AND COAXIALITY FOR PRECISION BUSHES

All dimensions in millimetres.



Housing Diameter	Tolerance on Internal Diameter of the Bush	Coaxiality Tolerance e
≤ 50	0.025	0.025
$> 50 \leq 80$	0.035	0.030
$> 80 \leq 120$	0.050	0.040
$> 120 \leq 150$	0.070	0.050

6.3.3.1 The axis to the dimension of which the tolerance frame is connected shall be contained in a cylinder of diameter "e" coaxial with the axis of datum A.

7. Width — The bush widths for given housing diameters shall be as given in Table 3.

TABLE 3 WIDTH OF WRAPPED BUSHES

All dimensions in millimetres.

Housing Diameters	5	10	15	20	25	30	40	50	60	70	80	100
6 and 7	×	×										
8 to 10		×										
11 " 15		×	×	×								
16 " 20			×	×	×							
21 " 25			×	×	×	×						
26 " 34				×	×	×	×					
36 " 48					×		×	×				
50 " 57							×		×			
60 " 67						×		×	×	×		
70 " 80							×		×		×	
85 " 150								×		×		×

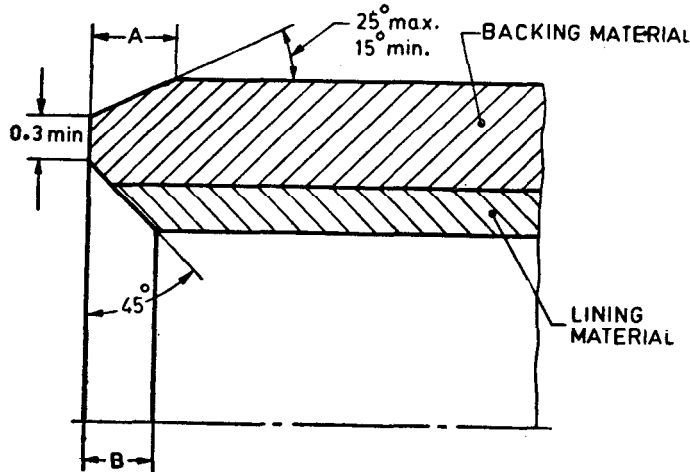
7.1 The tolerance on width shall be ± 0.25 . Wider tolerances may be accepted by agreement between the user and the manufacturer.

8. Constructional Details

8.1 Chamfers — Shall be as given in Table 4. The internal chamfer angle when it exists is equal to 45° and the values of B are given for guidance only.

TABLE 4 CHAMFERS

All dimensions in millimetres.



Housing Diameters	External Chamfer A	Internal Chamfer B (Guidance Only)
11 to 25	0.4 to 1	0.5
26 „ 80	0.8 „ 1.6	0.7
85 „ 150	1 „ 2.5	1

Note 1 — To facilitate fitting, the housing shall have a chamfer of narrow angle.

Note 2 — Bushes of wall thickness 0.75 mm and bushes of diameter less than 10 mm are normally not chamfered but all edges shall be free of burrs.

Note 3 — Chamfers may be produced by methods other than machining, in which case the form, angle and the length of the chamfers shall be agreed between the user and the manufacturer.

8.2 Oil Holes — Oil holes are normally pierced in the strip before wrapping and are thus distorted after wrapping, so that their diameter may not be directly defined. This distortion shall be taken into consideration while selecting proper hole size. The recommended practice is to make the hole 0.4 to 0.5 mm larger than the nominal size required in the finished bushing. Oil holes are specified by the diameter of the plug gauge which may be fitted in the hole and by the minimum permissible distance between the hole and each end of the bush (see Fig. 2).

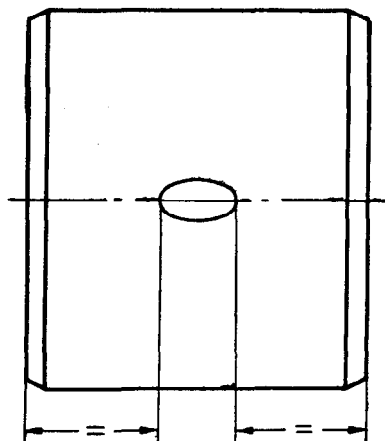


FIG. 2 LUBRICATING HOLE

8.2.1 The size of oil hole shall not be less than 1.5 times the wall thickness of the bush with a minimum size of 3 mm.

8.2.2 The pierced holes may not be situated in zones represented by the shaded areas as shown in Fig. 3.

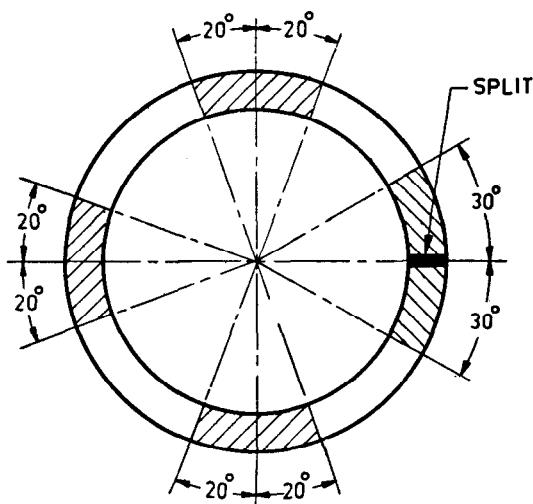


FIG. 3 RESTRICTION ON POSITION OF LUBRICATING HOLES

8.2.3 When the pierced hole is positioned symmetrically in the blank before forming, the developed view of the bush shall be as shown in Fig. 4.

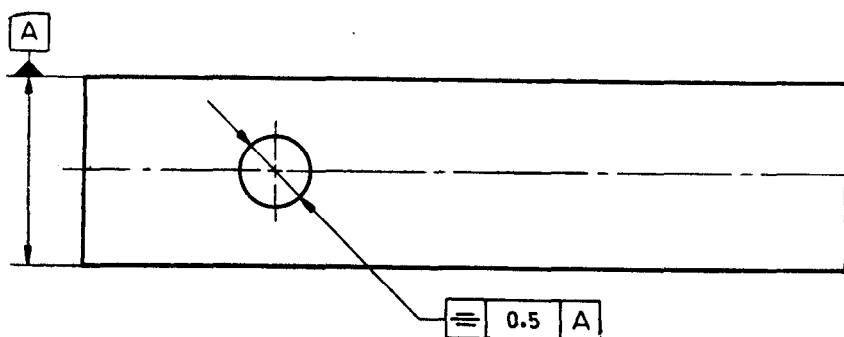


FIG. 4 DEVELOPED VIEW OF BUSH WITH HOLE

8.2.4 Oil holes may be drilled after wrapping in which case their location need not be restricted as indicated in Fig. 3. They shall be defined by their diameters with a tolerance of ± 0.25 .

8.3 Grooves

8.3.1 Groove forms — The grooves are normally formed in the strip before wrapping. They become distorted after wrapping. The width of the groove l , the radius R and the angle θ shall be given as nominal values, without tolerances. The typical forms are shown in Fig. 5.

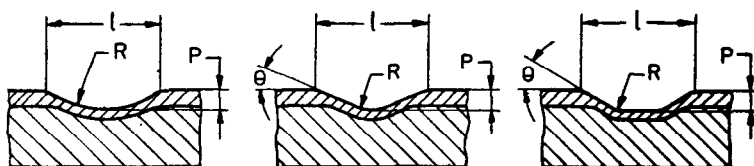


FIG. 5 GROOVE FORMS

8.3.2 Groove depth — The maximum depths of grooves shall be as given in Table 5.

TABLE 5 DEPTH OF GROOVES

(Fig. 5)

All dimensions in millimetres.

Wall Thickness	Maximum Depth <i>P</i>
0.75	0.25
1.0	0.30
1.5	0.50
2 or greater	0.60

8.3.2.1 For ease of measurement the thickness of wall remaining at the base of groove shall be specified on the drawing, with a tolerance of ± 0.1 .

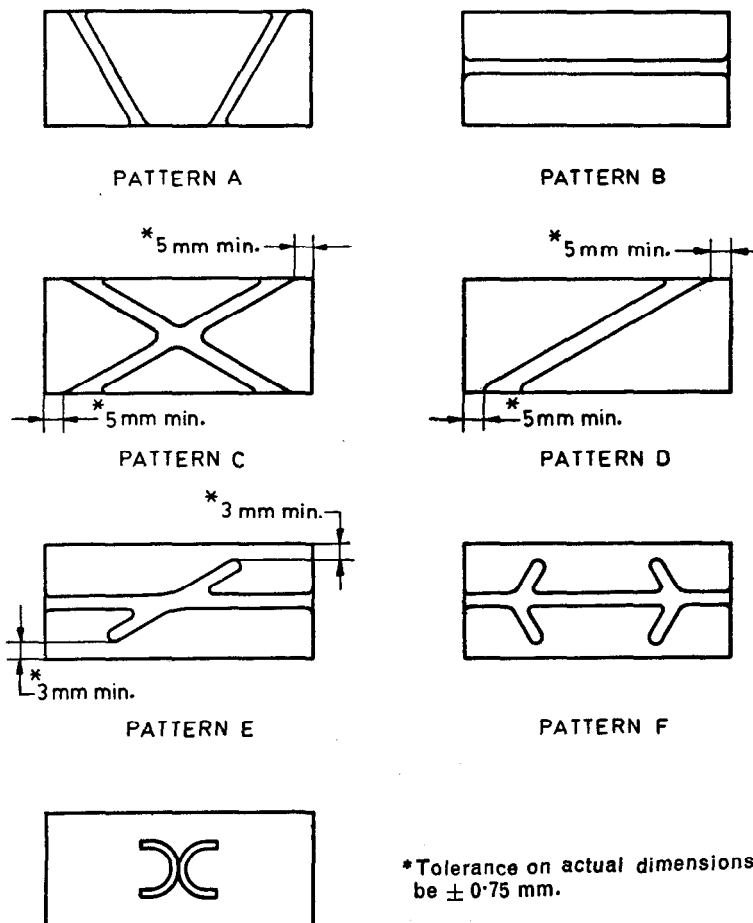
Note 1 — Cracks in the lining material are permitted in the grooves provided that particles of lining do not become detached.

Note 2 — On bushings with embossed/coined grooves a swelling of maximum 0.1 mm due to the stamping operation surrounding the groove within 10 mm is permissible. This also applies to the reliefs stamped around holes and slots.

Note 3 — The maximum permissible groove depth may be reduced for certain lining materials.

Note 4 — If the grooves are required deeper than the maximum permitted, they shall be machined.

8.3.3 Position and patterns of the grooves — Since numerous means of lubrication are employed the pattern of grooving design is quite varied. Some of the popular embossed/coined groove forms are shown in Fig. 6.



PATTERN G
FIG. 6 WRAPPED BUSHES, POPULAR GROOVE PATTERNS

8.3.1.1 The preferred tolerances for groove locations shall be as indicated in Fig. 7.

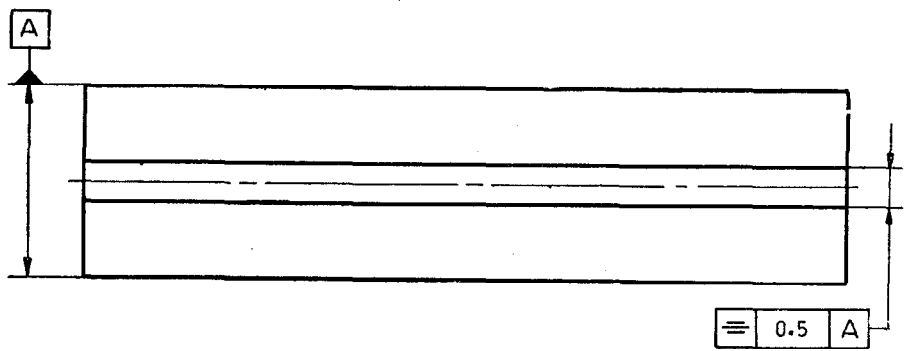


FIG. 7 BUSH WITH CENTRAL ANNULAR GROOVE (DEVELOPED VIEW)

8.4 *Ball Indentations* — Ball indentations on the surface of the bushing provides small reservoir which retain the lubricants and are very beneficial in grease lubricated applications during initial starting.

8.4.1 This indentation of the bushing surface may be used in conjunction with any groove, cross-section or pattern. Size and location of indent will vary slightly depending on manufacturer (see Fig. 8).

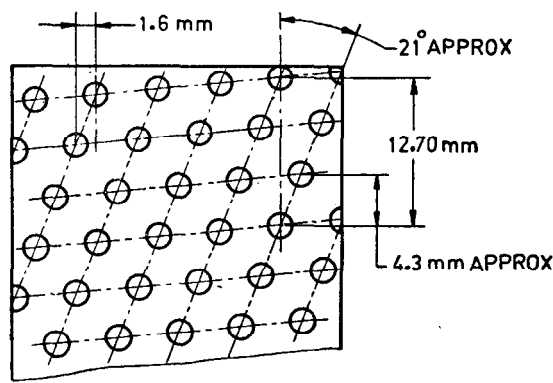


FIG. 8 BALL INDENTS

Note — Ball type indents may be 2 or 3 sizes depending on the end use of the bushings. The usual diameters are 2, 2.4 and 3.2 mm and the depth may be from 0.4 to 0.5 mm depending on a 'No finish' or 'Finish in place' applications.

8.5 *Split Gap* — The maximum split gap of bush in free state shall be as given in Table 6.

TABLE 6 SPLIT GAP

All dimensions in millimetres.

Bushing Outside Diameter	Maximum Split Opening (Free State)
Up to 38	1.5
40 " 80	3.0
Over 80	6.0

8.6 Machining Allowances — The nominal machining allowance for bushes to be finished by user shall be as under:

<i>Operation</i>	<i>Machining Allowance on Nominal Diameter (mm)</i>
Boring	0.25
Broaching	0.25
Reaming	0.15
Burnishing	0.05

9. Checking Method for Bush Outside Diameter — The external diameter of wrapped bushes may not be measured in the free state. One of the two checking methods given in Appendix D may be used, but all are not suitable over the whole range of bushes covered in this standard. The accuracy of the check varies according to the method adopted.

10. General Requirements — Defects on the backs of bushes that have been caused by details made on the strip material before forming, such as notes, grooves or indentation, may be permitted. Also as rolled steel strips are used to manufacture bi-metallic bushes, local defects on bush outside diameter due to original dents, pit marks, etc, as present on steel strips may also be permitted.

10.1 Wrapped bushes may be supplied with or without an allowance for machining in the bore. In the first case, they shall be finished in a suitable way after they have been fitted in their housings. The later type bushings are pre-bored by the manufacturer and may be used without any machining, such bushes are generally termed as pre-finished bushes. It shall be noted that the use of pre-finished bushing does not give same tolerance on clearance (due to stack-up of tolerances on housing and bush outside diameter/wall) as achieved with a bush having machining allowance to be finished in position.

11. Surface Finish

11.1 Housing — Roughness grade N7 to N8 conforming to IS : 3073-1967 'Assessment of surface roughness'.

11.2 Bush Bore — Surface finish of bore of pre-finished bushes shall not exceed roughness grade N6 conforming to IS : 3073-1967.

11.3 Shaft — The shaft surface finish shall be roughness grade N5 conforming to IS : 3073-1967.

12. Designation — The wrapped bushes shall be designated by housing diameter, bush wall thickness and bush lining material suffix.

12.1 A letter indicating special features of bush lining material shall be suffixed to the designation in the following cases:

<i>Bush Lining</i>	<i>Suffix</i>
White metal tin based	WM
White metal lead based	WML
Copper based alloy un-plated	CL
Aluminium based alloy	AL
Any other material	SP

12.2 The bush finish suffix shall be as given below and shall appear after lining material number:

<i>Type</i>	<i>Denotion</i>
Pre-finished	P/F
Un-bored	U/B
Semi-finished	S/F

12.3 A bush having housing diameter 50 mm and wall thickness 1.5 mm, using bush lining as copper based alloy supplied in pre-finished condition shall be designated as:

Wrapped Bush 50 — 1.5 CL — P/F IS : 4757

13. Marking — The wrapped bushes shall be marked with housing diameter, wall thickness and the manufacturer's trade-mark. The marking shall not interfere, through burring or distortion, with the pressfit or the running clearance.

13.1 ISI Certification Marking — Details available with the Indian Standards Institution.

14. Packing — Shall be subject to an agreement between the purchaser and the supplier.

APPENDIX A

(Clause 4)

COMPOSITION OF MATERIALS FOR WRAPPED BUSH LININGS

Material

	<i>Sn</i>	<i>Sb</i>	<i>Cu</i>	<i>Pb</i>	<i>As</i>	<i>Fe</i>	
<i>Tin based white-metal</i>							
Sn Sb8 Cu4	88-90	7-8	3-4	0.35 <i>Max</i>	0.1 <i>Max</i>	0.1 <i>Max</i>	
<i>Lead based white-metal</i>							
i) Pb Sb10 Sn6	5-7	9-11	0.7 <i>Max</i>	80-86	0.25 <i>Max</i>	0.1 <i>Max</i>	
ii) Pb Sb15 Sn10	9-11	14-16	0.7 <i>Max</i>	71-77	0.6 <i>Max</i>	0.1 <i>Max</i>	
iii) Pb Sb15 Sn As	0.9-1.7	13.5-15.5	0.7 <i>Max</i>	80-84	0.8 1.2		
<i>Copper based alloys</i>							
i) Cu Pb30	0.5 <i>Max</i>	—	R*	26-33	—	—	
ii) Cu Pb24 Sn4	3-4.5	—	R*	19-27	—	—	
iii) Cu Pb8 Sn4	3.5-4.5	—	R*	7-9	—	—	
iv) Cu Pb10 Sn10	9-11	—	R*	9-11	—	—	
<i>Aluminium based alloys</i>							
	<i>Al</i>	<i>Cu</i>	<i>Sn</i>	<i>Ni</i>	<i>Fe</i>	<i>Si</i>	<i>Mn</i>
i) Al Sn20 Cu	R*	0.7-1.3	17.5-22.5	0.1 <i>Max</i>	0.7† <i>Max</i>	0.7† <i>Max</i>	0.7† <i>Max</i>
ii) Al Sn6 Cu	R*	0.7-1.3	5.5-7	1.3	0.7† <i>Max</i>	0.7† <i>Max</i>	0.7† <i>Max</i>

*R = Remainder

†Total Si + Fe + Mn not to exceed 1%.

APPENDIX B

(Clause 4)

COMPOSITION OF STEEL BACKING MATERIALS*For aluminium based and white-metal alloys*

Cold rolled, bright annealed free from surface defects, such as pits, roaks, laps and internal laminations

Chemical analysis

	<i>Percentage</i>
Carbon	0.12 Max
Manganese	0.5 Max
Silicon	0.35 Max
Sulphur	0.05 Max
Phosphorus	0.05 Max
Hardness (HV 10)	100 — 120 VPN

For copper based alloys

Cold rolled, free from surface defects such as pits, roaks, laps and internal laminations

Chemical analysis

	<i>Percentage</i>
Carbon	0.15 Max
Manganese	9.7 Max
Silicon	0.35 Max
Sulphur	0.05 Max
Phosphorus	0.05 Max
Hardness (HV 10)	170 to 210 VPN

APPENDIX C

(Clause 6.3.2.3)

METHOD FOR CHECKING INTERNAL DIAMETER

C-1. The wrapped bush shall be fitted in a ring gauges, the calibrating bore diameter of which corresponds to the housing internal diameter. The bore of the ring gauge shall be made to the tolerance $\pm \frac{1}{2}$ IT8.

C-1.1 The length of the ring gauge shall be at least equal to the width of wrapped bush.

C-1.2 After the wrapped bush has been fitted in the ring gauge, its internal diameter shall be GO and NO GO plug gauges. The diameters of the plug gauges shall be made to the tolerance of $\pm \frac{1}{2}$ IT3.

C-2. This method of checking is destructive and may therefore, only be used in a method of checking by sampling.

C-2.1 In order to carry out a non-destructive check, the diameter of the ring gauge may be chosen larger than the maximum diameter of the housing and with the diameter of plug gauges modified accordingly, but the accuracy of such a check will be lower.

APPENDIX D

(Clause 9)

METHODS OF CHECKING BUSH OUTSIDE DIAMETER

D-1. Checking of peripheral length under load in the apparatus described shall be as given below.

D-1.1 The apparatus consists essentially of a checking gauge of internal diameter D cut lengthwise into two equal parts called 'checking blocks' which may move towards each other under the action of a force F known as the 'checking load' (See Fig.9).

When a solid cylindrical plug gauge of nominal diameter D is placed between the checking blocks and a force F is applied, there is a gap between the parting lines of the checking blocks.

The apparatus is fitted with a suitable device capable of measuring the variations of h . The procedure described above is used to effect the initial setting of the measuring device.

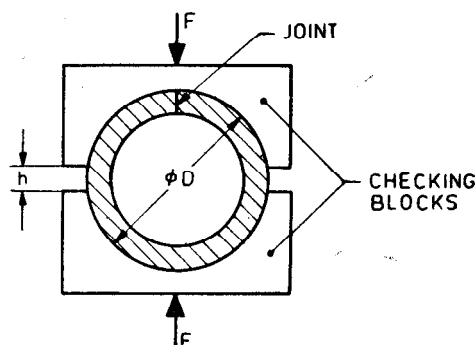


FIG. 9 APPARATUS FOR CHECKING OF PERIPHERAL LENGTH UNDER LOAD

To check a batch of wrapped bushes of theoretical external diameter in the free state d , successively place each bush between the checking blocks, apply the checking load, and read the variation of h .

The variations of the external diameter d of the wrapped bushes are related to the measured variations of h by the formula:

$$\Delta d = \frac{2 \Delta h}{\pi}$$

If ' T ' is the chosen tolerance on the external diameter of the wrapped bushes, check that

$$\Delta h \leq t \times \pi/2$$

the recommended value of tolerances for outside diameter shall be as in Table 7.

TABLE 7 TOLERANCES FOR OUTSIDE DIAMETER

All dimensions in millimetres.

Outside Diameter	Outside Diameter as Formed	Outside Diameter as Grounded or Sized
6 to 38	0.037	0.025
10 to 100	0.050	0.037
105 and above	0.075	0.050

Note 1 — The checking load F shall be chosen so as to ensure satisfactory contact between the external surface of the wrapped bush to be checked and the internal surface of the checking blocks.

Note 2 — The stiffness of the assembly shall be such that the application of the load does not cause significant distortion of the checking blocks.

D-1.2 Calculations of Checking Parameters D and F

If,

 L is nominal width of wrapped bush; d is theoretical external diameter of wrapped bush in the free state; e_1 is the thickness of the wall when made of steel; and e_2 is the thickness of the wall or lining when made of copper or aluminium alloy;

then,

 $S = L e_1$ for bushes made of steel and for bushes made of steel with a white metal or a plastic lining; $= L [e_1 + (e_2/2)]$ for bushes made of steel with a copper alloy lining; $= L (e_2/2)$ for bushes made of copper alloy; $= L [e_1 + (e_2/3)]$ for bushes made of steel with aluminium alloy lining; and $= L (e_2/3)$ for bushes made of aluminium alloy;

The value of D , expressed in millimetres, and the value of F , expressed in newtons, may then be determined from the formula in Table 8.

TABLE 8 CHECKING PARAMETERS

Checking Parameter	For $d < 12$	For $d \geq 12$
D	$d_{Max} - 0.006$	$d_{Max} - 0.012$
F	$3000 \frac{S}{D}$	$6000 \frac{S}{D}$

Note 1 — In certain cases the calculations may be simplified by calculating S as the product of L and the total wall thickness and by modifying accordingly the coefficient 3 000 or 6 000 to calculate F .

Note 2 — The calculated value of F shall be rounded to the nearest multiple of 250 for values of $d < 12$; or 500 for values of $d \geq 12$.

Note 3 — It may happen that for certain sizes of bushes the apparatus available may not accept the calculated load F . This case shall be dealt with by agreement between the manufacturer and the user.

D-2. Checking of External Diameter by Insertion of the Wrapped Bush into, GO and NO GO Ring Gauges — The wrapped bush shall be a hand push fit in the GO ring gauge and shall not be able to enter the NO GO ring gauge under hand pressure.

D-2.1 The diameter of the GO ring gauge shall be equal to the maximum theoretical external diameter of the wrapped bush in the free state. That of the NO GO ring gauge shall be equal to the minimum theoretical external diameter of the wrapped bush in the free state.

The bore of the ring gauges shall be made to the tolerance $\pm \frac{1}{2}$ IT3 and their length shall be at least equal to the width of the wrapped bush to be checked.

D-2.2 Checking shall take place in ring gauges that have a sufficient stiffness to compensate for the pressure applied by the wrapped bush inserted in their bore.

D-2.3 These ring gauges shall have a chamfer of narrow angle or a sufficient radius to facilitate the entry of the wrapped bush to be checked.

EXPLANATORY NOTE

This standard was earlier prepared by Rolling Bearings Sectional Committee, EDC 39 in 1968. Consequently on setting up of Plain Bearings Sectional Committee, EDC 80, this subject was transferred from EDC 39 to EDC 80. This committee then felt the need of revising this specification to be in with the current international practices.

This standard covers the most widely range of sizes. Below 6 mm and above 150 mm manufacture is possible but the size details shall be as per the application. The requirements of thrust washers which were earlier covered as part of the earlier version have been deleted.

This standard normally conform to ISO 3547-1976, 'Plain, bearing — Wrapped bush — Dimensions tolerances and methods of checking'.